Farmworker Exposure to Cholinesterase-Inhibiting Insecticides in Northern Colorado

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Abstract for Preliminary Study

Forty-five (N=45) Hispanic farmworkers were followed over a two year period to determine if there was an averse effect on their plasma or red blood cell cholinesterase (ChE) due to their anticipated chronic exposure to anticholinergic insecticides. Twenty-six of the subjects completed the study. Blood was analyzed during three different time periods: July and August(1987), March and April(1988), and July and August(1988). A questionnaire and physical examination were also performed. Plasma ChE was found to be inhibited during the periods of heaviest pesticide use in Northern Colorado. Red blood cell ChE was found to have a possible rebound action due to chronic exposure. Other factors that seemed to affect ChE levels were age, ETOH intake,and number of years worked in the fields. In addition, it was noted that only 6.5% of the farmworkers wore protective clothing.

Two Year Preliminary Study

Pesticides that contain organophosphates have been in agricultural use since the early 1950's. Despite initial enthusiasm and subsequent disillusionment, these pesticides retain a significant place in the control of pests in our nation. Depression of plasma pseudocholinesterase and/or red blood cell acelylcholinesterase enzyme activities are generally indications of excessive organophosphate exposure and affect serum cholinesterase in laboratory animals.[2-13,17-18] It is significant that these effects are not clearly understood, yet the chemical is so commonly used.

Cholinesterase has been shown to be inhibited in organophosphate exposure. A depression of 25% is generally regarded as significant.[19] It has recently been reported that initial inhibition of cholinesterase can cause a later rebound effect of cholinesterase that would be above the normal range found in the serum.[20]

The broad purpose of this initial descriptive study was to obtain background information on organophosphate exposure in humans over the course of two growing seasons.

The special needs of the migrant farmworker population are both medical and environmental. The medical need is well documented by the fact that the types and severity of infections are complicated by their negative environmental situation.[21-24] Because of their transitory state of farmworkers and other possible confounding variables such as the healthy worker effect ie: most migrants working in colorado are younger than the

average population, it is very difficult to determine the long term effects to low exposure to chemicals that adversely affect the cholinesterase in humans. It has been suggested that cholinesterase levels may be lowered in acute exposure and increased with exposure over a long period of time.[25] Additional variables that may effect exposure are personal habits, such as use of protective clothing worn during working hours.

Procedures

1) Subjects

There is little question that migrant field workers receive varying degrees of exposure to pesticides.[5-7,26-28] For the purpose of this research, a group of Hispanic males between the ages of 18 and 55 were selected for studying. The group was comprised of an original 45 farmworkers, who worked primarily in corn, cabbage, onion, and squash in the service area of Plan de Salud del Valle in the front range counties of northern Colorado.

This study is a "with-in-subject" design, ie: each farmworker served as their own control. This was designed as an initial survey and each subject had blood drawn a three deferent times: 1) During the peak of Colorado's crop growing season of 1987(July and August) typically the period of greatest exposure to pesticides; 2) In March and April (1988) before exposure occurred; and 3) during the period of Colorado's growing season of 1988(July and August). During the first blood draw, all participants were provided with educational material and information on how to limit exposure. During the third blood

collection period, the subjects were asked detailed questions about their work history that might effect exposure.(Appendix A) In addition, subjects tested during the high exposure period(1988) were asked about symptomatology that they might be experiencing. The interviewer asked open-ended questions about medical complaints or health concerns.

Subjects were then given a physical examination. The following was recorded A) Heart Rate, B) Blood Pressure, C) Knee Reflexes, D) Short-Term Memory, E) Sense of Smell, F) Balance, G) Papillary Dilatation, H) Gag Reflex.

2) Interviewing

Initial interviewing with subjects included an explanation of minor risks associated with venepuncture and potential benefits of participating (follow-up treatment in the event of abnormal findings). Subjects were also given an explanation of subject's rights (choice, anonymity, confidentiality, and informed consent); and the signing of a consent form to sign. A study questionnaire was then assessed for individual variables. Included on the questionnaire was information about: a) number of years worked in the fields, b) crop that subject worked in the day blood was drawn, c) age, d) use of pesticides, e) amount of alcohol consumed in a weeks time and f) protective clothing that was worn by subject, if any.

Patient education programs, already in place at the Salud Health Clinics, were not withheld from any patient regardless of participation in the study.

3) Blood Sampling

A total of three samples were collected from each farmworker. One sample from each subject was collected at three points during the duration of the two years; a) In-Season(July-Aug. 1987), b) Pre-Season(April-May 1988), and c) In-Season(July-August 1988).

Biochemical Assay

Red blood cell and plasma cholinesterase was determined by measuring pH levels in the blood. All testing for Cholinesterase was done on the sergeant Welch pH Meter, which has an estimated validity of 0.01.

Lab Collection

A series of steps were followed in the collection of the blood to ensure accuracy of the biochemical assay. (Appendix B)

4) Data

Cholinesterase levels from 1987 on the same individuals were compared with 1988 levels to determine differences. Cholinesterase levels were correlated with physical findings from physical exams and selected answers from questionnaires.

Only 26 subjects that finished the 2 years are reported in the following results.

Chart 1

This data represents the percent change in Cholinesterase levels from 1987 In-Season to 1988 Pre-Season.

	# Increased	# Decreased	# Unchanged
RBC	20(77%)	4(15%)	2
Plasma	24(92%)	0(0%)	2

Chart 2

This data represents the percent change in Cholinesterase levels from 1988 Pre-Season to 1988 In-Season.

	# Increased	# Decreased	# Unchanged
RBC	8(31%)	15(58%)	3
Plasma	10(38%)	13(50%)	3

Chart 3

This chart represents the percent change in Cholinesterase in subjects between 18-34 years of age and subjects above 34 years of age.

Age	18-34	35+
RBC	-10.2%	+5.7%
Plasma	+4.3%	-4.2%

Chart 4

This chart represents the percent change in cholinesterase in subjects that worked in the field between 1-10 years and subjects working greater than 10 years in the fields.

Years	1-9	10+
RBC	+2.4%	-2.4%
Plasma	-7.5%	-2.1%

Chart 5

This data represents the average percent change in cholinesterase in subjects reporting ETOH use vs. no ETOH use.

ETOH	Yes	No
RBC	-3.9%	-2.1%
Plasma	-2.5%	+7.5%

Chart 6

This data represents the average percent change in cholinesterase in subjects with hypertension and those subjects with normal blood pressure

BP	Increased	Normal
RBC	+2.2%	-4.0%
Plasma	+1.0%	-1.5%

Chart 7

This data represents the average percent change in cholinesterase in subjects that worked in the respective crops.

	Corn	Lettuce	Squash	Onions	Cabbage
RBC	-10.3%	+9.3%	-3.0%	-1.7%	+5.9%
Plasma	-4.6%	-5.3%	-7.7%	-6.0%	-1.1%

Discussion

An important point that should be remembered is the fact that the total number of subjects is low, and readers should not make definite conclusions on any of the data obtained. This author feels that this is a very important first step in the discovery of the potential chronic effect of cholinesterase inhibiting pesticides.

As was stated earlier, patient education was administered to each subject during the first and second year of the study. It is therefore surprising only 4(6.5%) of the subjects wore protective clothing. There are several possible reasons for this non-compliance among farmworkers. Among these possibilities is the fact that protective clothing means adding layers of clothing in an already uncomfortably hot climate. Another more significant reason is that EPA regulations are not adhered to by most of the agricultural community.

The data shown suggests two possible outcomes: 1) The possibility that the Cholinesterase level in the Red Blood Cells may have a rebound effect. The rebound effect of Cholinesterase has been described as going above the normal range as a response to constant exposure to an inhibiting chemical. Chart number 1 shows this possibility of a rebound effect by 77% of the subjects in the in-season blood-draw having increased RBC cholinesterase over the pre-season blood draw. The literature thus far reports only decreased levels in RBC cholinesterase. The implications of such an increase in cholinesterase is not clear but is unusual

since the bulk of previous studies have shown the adverse neurologic effects of the decrease in cholinesterase levels. 2) The second observation is that the variables of age, ETOH intake, and number of years worked in the fields seem to show possible chronic effects in cholinesterase levels in human subjects. Charts 3-5 seem to indicate that plasma cholinesterase falls more significantly with an increase in the variable component. Chart number 6 shows a possible correlation between the rebound effect and an increase in blood pressure.

The final chart attempts to correlate the effect on the blood cholinesterase levels with different crops. However, without further information it is difficult to made a connection.

In conclusion, the EPA has suggested that monitoring of farmworkers take place as a potential safeguard. It seems much more reasonable however to include the safeguards at the beginning of the process by requiring chemical companies to do exposure studies before the chemicals are licensed for use.

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